A NEWLY RECORDED VIRUS DISEASE OF SUGAR BEET IN BRITISH COLUMBIA

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Abstract

During a field study of virus vectors a mild virus disease of sugar beets (Beta vulgaris) was encountered. About 60% of the plants were infected ——— n the evidence of its relations with the aphid vector, Myzus persicae (Sulz.), and of its plant host range and symptoms, the virus was identified as beet western yellows. This disease has become widespread in the U.S. northwest within the last 12 years.

Introduction

During a study of the epidemiology of potato leaf roll virus (PLRV) (13) it was found that several hundred acres of sugar beets (Beta vulgaris L.) grown for seed were a prime local source of potential vectors of this virus, i.e. winged green peach aphids, Myzus persicae (Sulz.). The beet fields were closely grouped about the main, southerly, mouth of the Fraser River. The beet seed is normally sown in August and the young plants are left in the fields to overwinter. In this mild coastal climate they resume growth early in spring and the seed is harvested in July and August. A backlog of seed is stored to allow for unusual winters when, as in 1968-69, most of the plants are killed by frost.

The upshot of this work was to establish the presence in sugar beets of a virus disease not hitherto recorded in Canada.

Materials and methods

During the summer of 1968 aphids collected from sugar beet plants in the field were given test feedings on Physalis floridana Rydb. to ascertain if any were viruliferous for PLRV. The technique has been described elsewhere (4,5).

To determine whether the cause of symptoms that developed on P. floridana was a mild strain of PLRV, all apparently infected plants were re-colonized with non-viruliferous M. persicae. Late instar nymphs or apterous adults were used. After 5 days the aphids were transferred in groups of five to the sprouts of 35 virus-free (8) 'Netted Gem' or 'White Rose' potatoes (Solanum tuberosum L.). After 24 hr the aphid removed, tested for infectivity on P. floridana, and destxoyed. The potato plants were kept free from aphids in a greenhouse for 9 to 15 weeks. Stem tips from each were then indexed for PLRV on P. floridana by aphid transfers, as described (4,5).

To help identify the virus from sugar beet, plants representing 12 species and seven families were tested for susceptibility. The plants tested were Chenopodiaceae: garden beet (Beta vulgaris L. 'Detroit Dark Red'), spinach (Spinacea oleracea L. 'King of Denmark'), Chenopodium amaranticolor Coste & Reyn.; Compositae: zinnia (Zinnia elegans Jacq. 'Cactus-flowered Mix'), lettuce (Lactuca sativa L. 'Pennlake'); Leguminosae: pea (Pisum sativum L. 'Lincoln'); Cruciferae: broccoli (Brassica oleracea var. italica Plenck 'Italian Green Sprouting'), cauliflower (Brassica oleracea var. botrytis L. 'Snowball'), Chinese cabbage (Brassica ekinensis Rupr. 'Petsai'); Caryophyllaceae: gouse-ear chickweed (Cerastium vulgatum L.); and Polygonaceae: sheep sorrel or sourgrass (Rumex acetosella L.). Groups of 15 plants of each species were grown in soil in 5-inch clay pots. Ten plants of each group were infested at the first true leaf stage by three viruliferous aphids, two were fed upon by non-viruliferous aphids and three were kept as aphid-free controls. Test transmissions were made subsequently by allowing clean aphids to feed for 3 to 5 days on excised tips of the plants and then on P. floridana indicators.

Seventy seedlings of shepherd's purse, Capsella bursa-pastoris (L.) Medic., and 15 of Claytonia perfoliata Donn. were tested as indicators. Sugar beet plants from the field were tested in November, 1968, and in March, 1969.

Results

A virus was transmitted to P. floridana from 49 of 83 mature field-grown sugar beet plants tested in mid-August, 1968. The symptoms of stunting and mild chlorosis (Fig. 1) were indistinguishable from those caused

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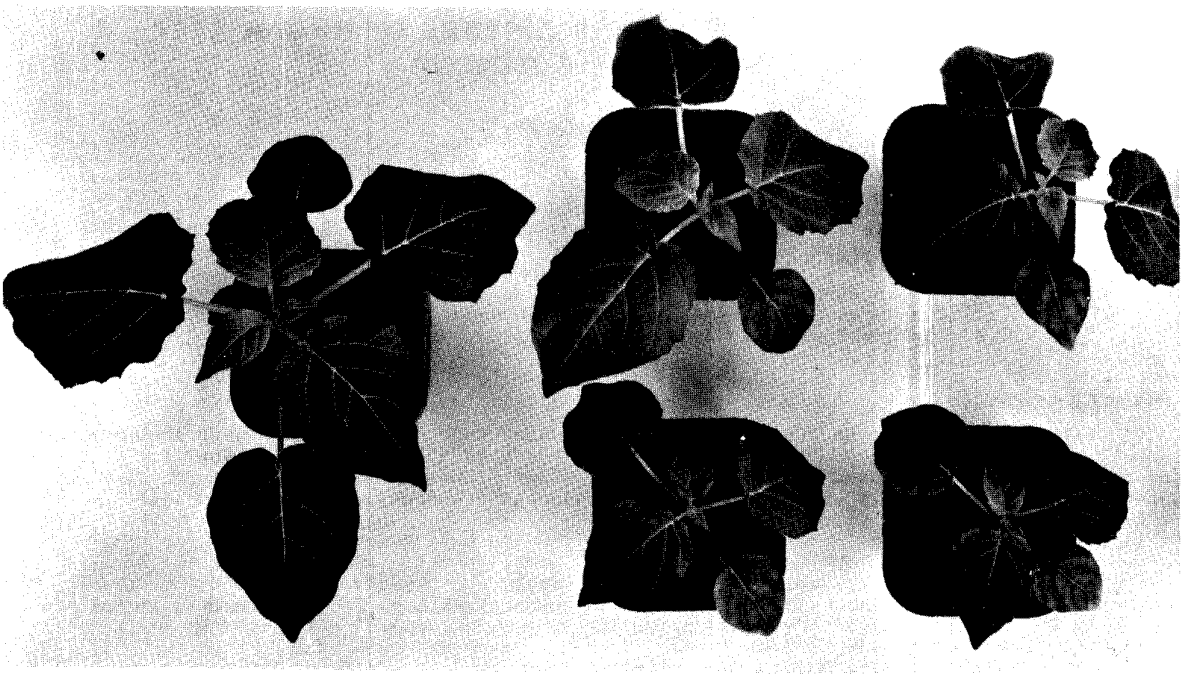

Figure 1. Symptoms in Physolis floridono of a virus from sugar beet. Left: healthy plant. Right: four infected plants

on P. floridana by mild PLRV (12) and by mild chlorosis virus (MCV) (6). A third possibility was beet western yellows virus (BWYV), but at that time the susceptibility of P. floridana to this virus was unknown.

The virus from sugar beet was transmitted readily by M. persicae but was not rub-transmissible, nor was it seed borne in sugar beet or P. floridana. All attempts to transmit the virus to potato with aphids proven to be viruliferous were unsuccessful. A total of 180 P. floridana indicators were used to index the 35 inoculated potatoes.

From the host range data given in Table 1 the virus was identified as almost certainly BWYV. This identity is supported by other evidence, such as successful transmission of the virus into and from radish (Raphanus sativus L.). In addition the symptoms produced on garden beet, zinnia, and shepherd's purse agree with published descriptions; also the virus was retained for life once an aphid was viruliferous; and maximum transmission rates were obtained with acquisition feedings exceeding 48 hr and transmission feedings of 24 hr. All these characteristics agree with those reported by Duffus for BWYV (1,2). The virus was not lost by nymphal aphids when they molted.

Shepherd's purse was inferior to P. floridana as an indicator. M. persicae failed to pick up the virus from several plants of shepherd's purse that had the characteristic symptoms (1) of stunting and swollen, purplish leaves. C. perfoliata was also inferior to P. floridana, both in ease of handling and in production of positive symptoms.

All six steckling sugar beet plants indexed in late November, 1968 were infected, and of 54 plants indexed in March, 1969, 33 (61%) were infected.

Discussion

On the basis of symptomatology, host range, aphid transmission, and geographic distribution, there is little doubt but that the sugar beet virus discussed here is beet western yellows virus. This is the most common of the components comprising the beet virus yellows complex. Since 1960 Duffus has clarified the host, vector, and economic relations of BWYV in California in a series of papers, and Russell (7) in England almost simultaneously did the same for sugar beet mild yellowing virus. The two appear to be very closely related.

Table 1. Transmission by Myzus persicae of a virus from sugar beet to various test plants and from test plants to Physalis floridana under greenhouse conditions, using a 5 day acquisition access time and a 24 hr inoculation access time with three aphids per plant

Test plant	No.* infected	Leaf symptoms on test plant	Transmission** to Physalis floridana
Garden beet	10	Rolling, twisting, yellowing	30
Spinach	10	None	29
Chenopodium amaranticolor	7	None	13
Zinnia	10	Faint yellow mottle	27
Lettuce	9	None	19
Pea	8	None	19
Broccoli	7	None	9
Cauliflower	6	Some faint yellow mottle	9
Turnip	5	None	8
Chinese cabbage	1	None	1
Mouse-ear chickweed	0	None	0 0
Sheep sorrel	0	None	0

* Number of plants infected of 10 inoculated.

** Number of plants infected of 30 inoculated.

The spread of the disease from California and the problems associated with it in seed and sugar crops of beets have been recorded by Duffus in Oregon (2), by Hills et al. in Arizona (3), by Wallis in Washington (10,11), and by Simpson in Idaho (9). It has become widespread in the northwest only in the last 12 years (10). It is almost certain that, although not previously recorded in British Columbia, the disease has been present here for several years.

BWYV is of considerable economic importance. It is the cause of June yellows of lettuce and radish yellows in California (1,2). It has been shown to reduce the yield of lettuce seed by about 40% (3), the yield of sugar beet seed by 13–151 (2,3) and the yield of sugar by 19%(2). These losses are about doubled when BWYV is combined with the more damaging beet yellows virus.

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